Fibers and Polymers 2013, Vol.14, No.9, 1535-1540 DOI 10.1007/s12221-013-1535-z

Predicting the Influence of Seam Design on Formability and Strength of Nonwoven Structures Using Artificial Neural Network

Vajihe Mozafary, Pedram Payvandy*, Seyed-Mansour Bidoki, and Rooholah Bagherzadeh[1]

Textile Engineering Department, Yazd University, Yazd, Iran
[1]*Textile Engineering Department, Amirkabir University of Technology, Tehran, Iran*
(Received December 31, 2011; Revised June 2, 2012; Accepted July 19, 2012)

Abstract: Formability which is also known as drapability is defined as the ability of a planar textile structure to be directly deformed to fit a three-dimensional surface without the formation of wrinkling, kinks or tears. According to human's desire for comfortable and high quality clothing, formability has a specific place in the textile industry so many studies have been conducted on understanding and predicting formability of textiles. Artificial neural network method is used in this study order to predict the influence of seam design on formability and tensile behavior of nonwoven structures. Our findings and analysis showed that seam design, seam allowance and weight of nonwoven layers are three main parameters significantly affecting the formability and overall tensile of nonwoven structure. Predicted values obtained from the ANN methodology were compared with the experimental data proving very good correlation between examined and predicted values.

Keywords: Seam design, Formability, Seam strength, Nonwoven fabric, Artificial neural network

Introduction

Fabrics mechanical properties are very important in predicting fabrics ultimate behavior and range of applications. Besides the flexibility and the elasticity, the Textile structures need acceptable and desirable levels of sufficient strength and formability. The mechanical properties of fabrics were first measured by Piers in 1930 [1]. He claimed that Bending length, thickness and structure are directly proportional to each other. Based on his findings; fabric's mechanical properties demonstrates the adaptation of applied forces which change the shape of fabric.

Ultimate behavior in clothing is significantly related to bending and drape of fabric. Moreover, some other elements turn effects on clothing's mechanical behavior such as sewing yarn and various joints. In recent years, stitching technology has been applied to change the formability of woven structures. Many studies have been conducted to analyze the effect of seam parameters on final properties of woven structures such as tensile, Bending and Shear.

The effect of sewing and fusing of interlining on drape behavior of men's suiting fabrics was inspected by Sharma. Comparisons were also made between different stitches (chain stitch and lock stitch); different seams for lock stitch and different types of interlinings for their effect on drape behavior of fabrics [2]. Jevsnik *et al.* [3] studied the influence of seam types and directions on fabric drape. Bekampiene *et al.* [4] examined the influence of stitching pattern, direction, location and stitching step on fabric deformational behavior. They illustrated that two types of sewing patterns were distinguished: periodic order and symmetric order. A few studies dealt with mechanical properties of stitched nonwoven fabrics. Ujevic *et al.* [5] investigated the influence of stitch density on sewn layers properties of car seat coverings.

Today artificial neural network (ANN) has shown a great assurance for modeling non-linear processes as within the textile industry alone, numerous applications have been reported. For example, Wang *et al*. [6] predicted bond qualities of fabric composite after washing and dry cleaning using a principal-Bp neural network model. Wong *et al*. [7] used the BP neural network to classify the stitching defects in the fabric. Hui *et al.* [8] investigated the capability of artificial neural networks and multiple logarithm regression methods for modeling seam performance of commercial woven fabrics based on seam puckering, seam flotation and seam efficiency. Kuo *et al.* [9] used neural network for recognizing fabric texture. Kim *et al.* [10] employed neural network for predicting the effect of pressing on bending rigidities of the face fabric, adhesive interlining and bonded composite fabric. Onal *et al.* [11] predicted the seam strength of notched webbings for the parachute assemblies. They figured out that following elements significantly affect seam strength: fabric width, folding length of joint and the interaction of folding length of joint and seam design.

Although nonwoven fabrics have been used in clothing, there is no previous study to predict strength and formability of stitched nonwoven-fabric composites. Hence in this work, the capability of artificial neural network method for predicting the formability and strength behavior of nonwoven fabrics based on seam property such as seam design, seam allowance and nonwoven weight were investigated.

Artificial Neural Network (ANN)

ANN system consists of a large number of processing elements called cell, node, unit or neuron. Training of the

*Corresponding author: peivandi@yazd.ac.ir